APPENDIX.

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Nature of Oils and Fats.

Fats and oils of animal or vegetable origin including lard and cottonseed oil, are not definite chemical compounds. On the contrary they all consist of mixtures of "glycerides of the fatty acids", of which some are solid and the others are liquid, and whether such products are physically liquid, semi-solid or solid depends upon the relative proportion of these well known glycerides. The glycerides comprise generally *linolin* and *olein* (which for reasons hereinafter stated are called "unsaturated" glycerides), and *stearin*, the term generally applied in the art, as well as in the patent in suit, to the glycerides of stearic and palmitic acids, which are called "saturated" glycerides (Walker, Q8, p. 286). These glycerides—stearin, olein and linolin—have different melting points, stearin having the highest and being a solid at ordinary temperature, and linolin having the lowest, both linolin and olein being liquid at ordinary temperatures. When these glycerides are mixed together by nature or design, the product is liquid, solid or semi-solid, as the case may be, according to their proportions. When the product is liquid, for example, cottonseed oil, the solid glycerides are held in suspension or solution by the liquid glycerides; but, where the product is semi-solid, the solid glycerides are not held in suspension or solution but are distributed in fine solid particles through the mixture, as in the case of lard; and, again, if the solid glycerides sufficiently predominate in the mixture, the product is a solid, as in the case of oleo stearin, or beef or mutton tallow (Walker Qs. 9-15, p. 287).

Thus cottonseed oil, olive old, lard, tallow and other fats and oils of animal and vegetable origin are all, in chemical composition, mixtures of the solid and liquid glycerides, and the consistency of the product depends upon the proportions of the glycerides found therein. (Chart opposite Rec. p. 302). Cottonseed oil becomes turbid and to some degree semi-solid, by its stearin separating out if its temperature is decreased, and hence, for using it as a table or salad oil in the winter time, it is a common commercial expedient to chill it to a low temperature until some of the solid glycerides crystallize and separate out of the mixture, and then to remove them, thereby changing the chemical composition (or proportions of glycerides) of the oil. Lard, like cottonseed oil, is a mixture of olein, linolin and those saturated glycerides, i. e. stearin and palmatin, which according to common usage are grouped under one name "stearin" (Richardson Q132, p. 356). By reason of the proportion in which these glycerides are found in lard, it is a semi-solid at ordinary living room temperatures; but, by removing some of the solid glycerides, the product becomes a liquid and is known as lard oil which is a matter of common knowledge. In cottonseed oil, the proportion of linolin is high, namely about 46% to 48%. Lard, however, is characterized by the presence of a very low proportion of linolin, namely about 8 to 10% and a large proportion of olein (Richardson, Q132, p. 356; Morrison, Q55, p. 199).

Process of Hardening Oils by Hydrogenation.

To understand the process of hydrogenation, which is referred to in the patent in suit, it is necessary to explain that a glyceride of a fatty

acid, *i. e.* stearin, olein or linolin, is a composite molecule consisting of a glycerine molecule and 3 acid molecules attached thereto. The glycerine radical or molecule is the same in each case and consists of 3 carbon atoms and 5 hydrogen atoms, indicated by the chemical symbol C_3H_5. Glycerine when separated is indicated as $C_3H_8O_3$. The acid radicals, i.e., stearic, oleic and linolic acids consist of atoms of carbon, hydrogen and oxygen, and they differ from each other only in the number of hydrogen atoms. Thus a molecule of stearic acid consists of 18 atoms of carbon, 36 atoms of hydrogen and 2 atoms of oxygen, and is chemically or symbolically written as $C_{18}H_{36}O_2$. Oleic acid has two less hydrogen atoms but it otherwise is like stearic acid, and it is symbolically expressed as $C_{18}H_{34}O_2$. Linolic acid has only 32 hydrogen atoms and it is symbolically expressed as $C_{18}H_{32}O_2$. When 3 molecules of acids are chemically united with 1 molecule of glycerine, water (H_2O) is split off, and the resulting composite molecule is termed the "glyceride of a fatty acid," or a "triglyceride". The molecules therefore of stearin (the triglyceride of stearic acid) is expressed C_3H_5 $(C_{18}H_{35}O_2)_3$. Similarly olein (the tri-glyceride of oleic acid) is C_3H_5 $(C_{18}H_{33}O^2)_3$; and linolin (the triglyceride of linolic acid) is C_3H_5 $(C_{18}H_{31}O_2)_3$.

It is theoretically possible that to one molecule of glycerine, the molecules of different acids may be attached, such as stearic acid, oleic acid and linolic acid, in which case the whole molecule is termed a "mixed glyceride" in contradistinction to a simple glyceride in which the three acid radicals or molecules are all chemically the same. But there are no analytical methods, by which these mixed glycerides can be accurately determined in

an oil or fat, *and it is only a matter of conjecture whether they are present.*

Thus Dr. Baskerville says:

> "We do not actually know the ratios of these different mixed glycerides. We do not know some of them. *We do not know whether they actually exist.*" (P. 457.)
>
> "They are hypothetical and I do not want to say they are actually in existence * * *" (p. 456).

In the patent in suit, and for practical purposes, the glycerides are considered as "simple" glycerides. And on this point Dr. Walker testified.

> "We do that for two reasons; first, because there is analytically no method by which we can determine how the glycerine is combined with the different acids. We have a method of determining the percentage of the stearin, olein and linolin in an oil or fat, if we assume that they are combined in this way as simple glycerides; that is, we have an analytical method which will give the percentage composition of an oil or fat in terms of its stearin, olein and linolin. If we consider them as mixed glycerides we have no analytical method of determining their relative proportions in an oil or fat.
>
> "The second reason is that from a digestion standpoint, the first thing that happens, as we have already seen is that these molecules are hydrolyzed; that is, water enters and the acids are freed.
>
> "When once separated from the glycerine, it is, of course, immaterial how they were combined, because then they are not now combined at all. In other words, they are all mixed up, for the moment they separate from the glycerine, so far as digestion is concerned, it is absolutely immaterial whether they

were combined of three acid molecules of one kind, with one glycerine, or whether different types of (acid) molecules were combined to one glycerine." (Rec., p. 295.)

In analyzing an oil or fat to ascertain the proportions of the component glycerides, the various acids are separated from the glycerine, and the percentages of the glycerides are established as conforming to the percentages of the different acids (Walker, p. 295; Morrison, p. 208).

By a simple chemical process, hydrogen may be added to linolic acid and to oleic acid to convert it into stearic acid. Thus by adding 2 atoms of hydrogen to oleic acid $C_{18}H_{34}O_2$, there is produced stearic acid ($C_{18}H_{36}O_2$), and similarly by adding to linolic acid ($C_{18}H_{32}O_2$), 2 hydrogen atoms, oleic acid is produced; or by adding 4 hydrogen atoms there is produced stearic acid. The reactions are as follows:

$$C_{18}H_{34}O_2 + 2H = C_{18}H_{36}O_2$$
$$C_{18}H_{32}O_2 + 4H = C_{18}H_{36}O_2$$

to convert oleic acid and linolic acid to stearic acid. Similarly to convert linolic acid to oleic acid, the reaction is

$$C_{18}H_{32}O_2 + 2H = C_{18}H_{34}O_2$$

The addition of hydrogen does not change the glycerine radical of the composite molecule, but is added only to the unsaturated acid molecule or radical and hence, by the addition of hydrogen to linolin, it may be converted to olein or to stearin, and the olein may likewise by the addition of hydrogen be converted to stearin. *The old products stearin and olein may be thus synthetically produced by chemically adding hydrogen to linolin.*

Stearin is called a "saturated" glyceride because there are present in the molecule as many hydrogen atoms as can possibly be joined to the carbon atoms. Linolin and olein are chemically known as "unsaturated glycerides" because they can be saturated, or converted, to stearin, by the addition of hydrogen as explained. The hydrogen and the carbon atoms are all united together by what are known as "bonds" of "valances", and wherever there are hydrogen atoms missing, as in oleic acid, at some point in the chain 2 carbon atoms are connected by *double* bonds. In stearic acid or stearin, there are no double bonds; in oleic acid there is *one* double bond to which two atoms of hydrogen could be supplied; and in linolic acid there are *two* double bonds which may grasp hydrogen atoms.

The chemistry involved in the hydrogenation of oils and fats is simple and it is explained at length by Petitioner's witness Dr. Walker on pp. 289 to 293 of the record, with the aid of charts, which have been reproduced and inserted in appropriate places in the record.

Methods of Identifying Oils and Fats.

As might be expected, various common methods have come into use by chemists for comparing and identifying oils and fats. All animal and vegetable oils and fats are mixtures of saturated and unsaturated glycerides, grouped as "stearin", "olein" and "linolin", but, as stated, the proportions of these components vary in the different oils and fats, and, consequently oils and fats have varying characteristics. Hence, when an unknown oil or fat is submitted to a chemist or expert for identification, he determines the chemical composition (proportions of its different glyce-

rides) and also the melting point or physical consistency thereof at ordinary temperatures, the iodine value, the titer, and the saponification value. He is able thereby to identify it as lard, cottonseed oil, peanut oil, olive oil, oleo stearin, etc. as the case may be. Some of these tests are more crucial than others.

The melting point.

The melting point of a fat is not to be relied on as a crucial test for the melting point of a given fat cannot be determined with accuracy as "these products have no sharp or definite melting points" (Rec., p 552). So also Lewkowitsch, an authority cited at the trial, says:

> "The several methods proposed hitherto for the determination of the melting point of fats, unfortunately lead to discordant results. Nor is this to be wondered at, if we remember that natural oils and fats are not definite substances, characterized by definite melting points, but are mixtures of a number of glycerides." (Chemical Technology of Oils, Fats and Waxes, Vol. I, p. 315; 5th Ed., 1913.)

The Halphen Test.

The Halphen test is likewise an unsafe guide. It depends upon certain impurities normally present in cottonseed oil. If these are removed or destroyed, the oil does not respond to this test (Baskerville, XQs. 82, 83, p. 272). Hence failure to respond to this test does not negative the presence of cottonseed oil. Dr. Baskerville, Respondent's expert, said of the Halphen test:

> "It is probably the best test for the detection of cottonseed oil, but it is not an absolutely final test. For instance, there are

other oils which will give that test. *Even lard will give that test* if the animals have been fed upon cottonseed meal" (Q23, p. 266) [1].

"Hence the Halphen color reaction can be obtained with lards, etc., which are absolutely free from admixed cottonseed oil. *It should be further noted that failure to obtain the color in the Halphen test does not prove the absence of cottonseed oil.*" Lewkowitsch Chemical Technology of Oils, Fats and Waxes Vol. II, p. 204, 5th Ed.

Saponification Value.

The ascertainment of the saponification value or number, of an oil or fat, is of some assistance in identifying an oil or fat. But the test alone would be of little value since most fats have a saponification number of 195; between 193 and 196. (Walker, Rec., p. 296.)

"The saponification number * * * is the number of milligrams of potassium hydrate which is required to unite with one gram or a thousand milligrams of the fat. In other words, it is the number of unit parts by weight of the potassium hydrate which is required to unite with one thousand unit parts by weight of the fat" (Walker, p. 296).

Iodine Number.

This is a test for determining the extent to which an oil or fat will unite with iodine, and thus measures its degree of saturation with hy-

1. The Halphen test consists in treating the oil in question with a reagent. This reagent is made by means of equal proportions of amyl alcohol and carbon disulphide with a trace of sulphur. Equal proportions of this reagent and the oil are taken and heated. If there is cottonseed oil present as such a positive test is indicated by a deep red coloration (Richter, Q30, p. 360).

drogen and its capacity of adding on or absorbing hydrogen. This test is crucial, although a natural fat or oil may vary in its characteritic iodine value to some extent, according to conditions. Thus the iodine value of lard varies from 46 to 70 (Thorp's Dictionary of Applied Chemistry, 1912 Ed., Vol. III, page 248).

Unsaturated glycerides will chemically unite with or add on iodine at the double bonds without the employment of a catalyst and the iodine number is the number of grams of iodine which are necessary to fill in all the double bonds of 100 grams of the fat. Hence the *iodine number measures the capacity* of the fat to absorb hydrogen, and is used to test the degree to which oil has been hydrogenized. Oleic acid has an iodine value of 90; linolic acid 180; cottonseed oil 108 to 110.

Chemical Composition or Proportion of Glycerides.

This test, which is accomplished by a simple mathematical formula after ascertaining the iodine value of the oil or fat, and the iodine value of its liquid fatty acids after separating such acids from the glycerine, shows the chemical composition of the oil, *i. e.,* the proportions of the stearin, olein and linolin.

Titer.

Since oils and fats have no definite melting or solidifying points, it is customary to determine what is called the "titer." The titer, generally speaking, is the temperature or critical point at which the fatty acids of the oil or fat solidify. More accurately, it is the definite or critical

point, during the solidifying of the fatty acids on gradually cooling them, at which the heat of the crystallization balances the heat of radiation (Morrison, Q175, p. 215; and Walker, p. 324).

Two oils or fats, which, when subjected to the various tests hereinbefore set forth, are shown to respond thereto in the same way, are for all practical purposes identical. Even though there are shown to be minor differences between them in any one of the tests, this is not controlling, since, according to common knowledge, oils and fats fluctuate somewhat with the age, race and food of the animal, and the climate, soil and variety of the plant, from which the oil or fat is derived. Of these various tests, the iodine value is the most important.

> "The determination of the iodine value furnishes one of the most valuable characteristics in technical fat analysis. If we have to identify the natural oil, fat or wax, the iodine value indicates in an unmistakable manner the class to which it may belong. The iodine value will thus, as a rule, lead in the quickest manner to the identification of a given natural oil, fat or wax. Furthermore, if a hitherto unknown specimen be under examination, the iodine value will at once point to the most likely class or group in which the new natural oil or fat should be placed in the system" (Lewkowitch Chemical Technology and Analysis of Oils, Fats and Waxes, Vol. 1, p. 415, 5th Ed.).

History of the Art of Hydrogenation.

The first disclosure of the fact that oils and fats could be hardened by the chemical addition of hydrogen to the unsaturated glycerides thereof, is contained in the British patent to Normann, No. 1515, dated January 21, 1903 (pp. 584-585), and the corresponding German patent No. 141,029, to Herforder Maschinenfett & Oelfabrik, LePrince & Siveke, dated August 14, 1902 (an English translation of which appears on pages 591 and 592 of the Record).

In the British patent, the process is thus briefly described:

> "I have found, that it is easy to convert by this catalytic method unsaturated fatty acids into saturated acids. This may be effected by causing vapours of fatty acid together with hydrogen to pass over the catalytic metal, which is preferably distributed over a suitable support, such as pumice stone. It is sufficient, however, to expose the fat or the fatty acid in a liquid condition to the action of hydrogen and the catalytic substance. For instance, if fine nickel powder obtained by reduction in a current of hydrogen, is added to chemically pure oleic acid, then the latter heated over an oil bath, and a strong current of hydrogen is caused to pass through it for a sufficient length of time, the oleic acid may be completely converted into stearic acid" (Rec. p. 585, lines 27 to 36).

Thus oleic acid is changed to stearic acid by the following equation:

Oleic acid	hydrogen		stearic acid.
$C_{18}H_{34}O_2$	$+2H$	$=$	$C_{18}H_{36}O_2$

It will be observed that Dr. Normann stated that, if the current of hydrogen is passed through

the oleic acid for a *sufficient* length of time, the oleic acid *may be completely* changed to stearic acid. Of course, if the current of hydrogen is stopped at any time before the oleic acid is completely converted to stearic acid, there is a *mixture* consisting of (a) stearic acid and (b) the oleic acid which has not been converted. Oleic acid is a liquid and stearic acid is a solid.. Hence one may carry on the process sufficiently to convert enough of the oleic acid to stearic acid, so that the mixture or product is a semi-solid, or he *may*, as Dr. Normann states, supply enough hydrogen until *all* the oleic acid is converted to stearic acid, in which case the product is a hard solid.

This is pointed out by Fokin, the Russian investigator, who showed that, on subjecting oleic acid to hydrogenation at a temperature of 184° 185°, after three-quarters of an hour a product is secured consisting of 18.3% stearic acid and 81.7% oleic acid. The "incompletely hydrogenized" oleic acid is thus oleic acid and stearic acid, in mechanical admixture.

On incompletely hydrogenizing oleic acid, at a temperature of 97°C, Fokin shows that at the end of 1 1-4 hours, a mixture of 32.31% stearic acid and 67.69% oleic acid and after 4 hours a mixture of 90-95% stearic acid and 10-5% oleic acid is produced (Rec. p. 598).

"Completely hydrogenized" oleic acid, is only another name for stearic acid, just as "incompletely hydrogenized" oleic acid, is another name for a mixture of oleic acid and stearic acid.

Dr. Normann in his British patent goes on to state that the hydrogenation process is equally applicable to all fats and oils, which are composed of glycerides.

"The same method is applicable not only to free fatty acids, but also to their glycerides occurring in nature, that is to say, to fats and oils. Olive oil will yield a hard tallow-like mass; linseed oil and fish oil will give smilar results.

"By the new method, all kinds of unsaturated fatty acids and their glycerides *may be easily hydrogenized*" (Rec. pp. 585-586).

The same physical changes occur in hydrogenizing an oil, such for instance as olive oil, as occur in hydrogenizing oleic acid. The oil, as its liquid molecules of unsaturated glycerides (such as linolin) are changed one after another to solid glycerides, or glycerides of higher saturation as olein, gets thicker and thicker and passes gradually from a liquid state to a state in which it is solid on cooling, so that one may supply the amount of hydrogen to give a product of the desired physical consistency, i. e. semi-solid or hard, as the case may be. On this point Dr. Bacon testified:

"Q59. Are you sufficiently familiar with the hydrogenation of olive oil to know what occurs in that hydrogenation from the initial stage in which the olive oil is in a liquid condition up to the stage at which it obtains a tallow-like consistency? A. Yes, I am.

"Q60. What occurs in that hydrogenation from stage to stage? A. Physically one notes that the liquid olive oil becomes first more viscous and gradually semi-solid, and finally the solid in the final product is exceedingly hard. It is a progressive reaction, passes through all of these various stages that I have enumerated.

"Q61. What happens to the unsaturated glycerides during these successive or progressive stages? A. The unsaturated glycerides are gradually saturated by the hydrogen.

"Q62. And the saturated glycerides; does anything happen to them? A. They are not

changed, no." (Rec., p. 409; see also Walker, Rec., pp. 299-300.)

In the British patent, Dr. Normann pointed out, in the words of a layman, that nothing happened to the oil during the hydrogenation, except to change the well-known unsaturated glycerides to the equally well-known saturated glycerides (or that the common oleic acid of commerce was converted to the common stearic acid), or, in technical language, that there were no "side or secondary reactions." He said:

> "Apart from the formation of small quantities of nickel soap, which may be easily decomposed by dilute mineral acids, the reaction passes off without any secondary reaction taking place." (Rec., p. 585, lines 38-40.)

The significance of this statement is apparent. Any food chemist is informed thereby, that, if the oil originally was edible, the process did not destroy its edibility, and that the hydrogenized product could be put to any use to which equivalent natural oils or fats had been put.

Thus, Dr. Bacon testified:

> "Q63. Does Normann specify anywhere in his patent any of the purposes for which his patents are intended? A. He does not. He says nothing in the patent as to what these products should be used for. The presumption is that they might be used for any purpose for which fats of that general character could be utilized. They might be used for making candles; they might be used for soaps; they might be used for edible purposes. By the passages I have read he has very carefully specified what the product is so that any chemist would know for what particular purposes it might be useful.
>
> "Q64. In the process of hydrogenation as described in the Normann patent from which you made citations; that is, the British pat-

ent No. 1515 of 1903, what would your conclusion be as to the edibility of the resultant product when the material hydrogenated was among those suggested by him, olive oil? A. If an edible olive oil was started with one would certainly obtain an edible hydrogenated product.

"Q65. Does his patent give one skilled in the art to fully understand that that would be the case? A. I think it does by defining the nature of the product, yes, sir. It does not say in so many words anything about edibility, but by defining the nature of the product it certainty would.

"Q66. What is the passage that would lead one versed in the art to know that starting with edible oil he would have as the final result an edible hydrogenated olive oil of tallow-like consistency? A. The passage in particular is: 'The reaction passes off without any secondary reaction.'

"Q67. This is the passage that you referred to in one of your earlier answers? A. Yes, sir. I might also say that in considering that last passage one should also consider what he says above in the paragraph that I noted before regarding the change of chemically pure oleic acid into stearic acid" (Rec. p. 410).

Dr. Bacon subsequently expressed the opinion that the reference by Dr. Normann to purifying the hydrogenized product by removing the small quantities of nickel soap, emphasized the inference that the product should be used for edible purposes, as otherwise the small amount of nickel soap would be of no consequence. (XQs. 258-262, p. 436.)

In refining cottonseed oil for edible purposes, an analogous process is employed, in removing the free fatty acids, by the use of caustic soda, which forms soap therewith. This soap is removed from the product (Burchenal, Qs. 950-955, p. 149).

The evidence of record shows that any oil or fat, which is originally edible, is edible at any stage of its hydrogenation, during its gradual conversion from a liquid to a solid, and this was conceded at the trial in a colloquy between the Court and the Respondent's counsel:

> "The Court: They are not putting in this evidence to show what anybody thought; they are putting it in *to show a fact that it is edible during all stages of progress* and you do not deny that?
> "Mr. Gifford: *No*" (Rec. p. 421).

Dr. Bacon affirmatively testified that:

> "In fact, in any process of hydrogenation with which I am familiar the hydrogenation does not change the edibility of the oil except in very rare cases where it may change a non-edible oil over into an edible oil like in the case of croton oil, but you start with any edible oil and subject it to hydrogenation the product is always edible." (Q128, p. 421.)

Normann did not patent his process in the United States, and therefore dedicated his process and the products obtainable thereby to citizens of the United States for all purposes to which they might be put.

Following the date of the Normann patent, other patents and articles were published, by persons attracted by the Normann process. Bedford in his British patent No. 2520 of 1907 (Rec. p. 587), describing a new form of hydrogenating apparatus, disclosed a special process of hydrogenation, and showed that mineral oil products could also be hydrogenated and hardened.

Erdmann's German patent (Rec., p. 592) disclosed another variation in the hydrogenating process, and showed that soft tallow solidifying at

31° C. could be converted into an incompletely hydrogenized semi-solid solidifying at 38° C.

Fokin in 1906 published results secured by using palladium instead of nickel as the catalyst and remarked the progressive nature of the process—hydrogenizing almond oil and olive oil to incompletely hydrogenized soft fats corresponding to beef or mutton drippings (p. 596).

Thus Fokin produced homogeneous food products which are of lard consistency and consisting of incompletely hydrogenized vegetable oils.

Dr. Bacon, in respect of this reference, testified as follows:

> "* * * I would call attention particularly to an article by Fokin in the Journal of the Russian Chemical Society, Volume 38, pages 855 to 858 of 1906, where this statement is made:
>
> "'The reduction of glycerides proceeds with more difficulty than that of the free acids nevertheless it is not difficult to convert linseed oil or any other drying oil whatever into substances with small iodin numbers, at first into products of the type of sunflower oil or poppy oil, and then into products analogous to sesame oil or cottonseed oil.
>
> "'Almond and olive oil undergo a metamorphosis into fats corresponding to beef or mutton drippings.'
>
> "I would wish particularly to call attention to the fact that beef or mutton drippings is what is known as beef tallow or mutton tallow; that is, the rendered fat of beef or mutton and is very close to the lard range in melting point and is actually used by many people for cooking and shortening purposes.
>
> "In the first paragraph spoken of when he says that to convert linseed oil into an oil of the type of sunflower oil or poppy oil and then into products analogous to sesame or cottonseed oil, he speaks about a progressive

reduction of iodin number; that is, the iodin number of linseed oil is, say, approximately 185, the iodin number of sunflower is approximately 120; the iodin number of cottonseed oil, say, approximately 110. So he is speaking about a progressive hydrogenation but still a hydrogenation very far short of completion" (Record, pp. 419-420).

Paal and Roth on July 11, 1908 (p. 599) published the results secured by using colloidal palladium as a catalyst. They expressed the opinion that hydrogenized fats were less liable to grow rancid than natural fats (p. 607), and gave results obtained in hydrogenating cottonseed oil, olive oil, lard, etc. They showed that hydrogenation destroyed the toxic qualities of croton oil (p. 611). They confirmed Dr. Normann's statement in his patent that it was possible to hydrogenize all kinds of animal and vegetable oils to complete saturation, if desired, by carrying on the process long enough and that by hydrogenizing short of completion, "incompletely hydrogenized" semi-solid products were produced.

It appears that the firm of Crossfield & Son, Ltd. of England, early became interested in the Normann patent and process, and in 1904 employed Edwin Cuno Kayser to work upon that process, which he did for about three years. During this period, apparently the Normann process was commercially developed at Crossfield's, with Normann's aid, and Kayser, becoming fully acquainted therewith, determined to exploit it commercially in this country.

In the fall of 1907, Kayser wrote to the respondent, The Procter & Gamble Company, whose business was then the manufacture of soap, that he proposed visiting the United States for the purpose of introducing "a process of the greatest

importance to soap manufacturers," that he had manipulated the process for three years (*i. e.* since 1904), and "was the only person thoroughly acquainted therewith." (Rec., p. 130.) This process was the Normann process as developed at Crossfield's (Q799, p. 71), and did not differ therefrom.

After a brief correspondence with Mr. Burchenal, Kayser came to Cincinnati and saw him in November, 1907. Kayser was secretive and would not disclose the process until a preliminary contract was signed on December 5, 1907 (Q54, p. 7; Q31, p. 5; Q1018, p. 157). He brought with him samples of incompletely hydrogenized oils, including cottonseed oil and corn (maise) oil and showed them to Mr. Burchenal (Qs37-42, p. 6). Although Mr. Burchenal recollected that these samples were "very hard" an original record (p. 76) gives an analysis of them, by Dr. Bender.

> "* * * the samples from J. Crossfield & Sons, which showed an iodine value of 52.26 and a melting point of 39.3° C." (Rec. p. 76).

These samples of incompletely hydrogenized oil were "light in color, pale yellow or almost white (Q53, p. 7). They had an iodine value of 52.26 close to the range of 55 to 80 recited in the patent in suit, and a melting point within the melting point range 33-40° C. of the patent. Dr. Bender noted on the record that another sample in the laboratory had a higher melting point, saying "(The laboratory sample melted at 49.9° C.)" (Rec. p. 76).

At the date of the first interviews between Mr. Burchenal and Mr. Kayser, Mr. Burchenal knew nothing about hydrogenation, and did not even know that the samples which Kayser showed him

were hydrogenized and had never heard of hydrogenized oils (Q186, p. 18). He was not familiar with lard compounds or artificial lard (Q403, p. 35). He was the nontechnical manager of the Respondent, then engaged in soap making.

After the preliminary contract was signed, Kayser set to work to build and erect at the Respondent's factory, from sketches which he made (Q61, p. 8; Q16, p. 101) a small experimental plant for hydrogenating oils. This work was completed in January, 1908. The hydrogenating apparatus was like that shown by Figure 1 of Kayser's patent No. 1,004,035, shown on page 571 of the Record (Q34, p. 102) and capable of hydrogenating a batch of about 20 pounds of oil (Qs. 7-52, pp. 101-103). The process and apparatus were disclosed in detail to Burchenal and Anderson (Respondent's Superintendent) in January, 1908, and were kept in strict secrecy (Q178, p. 17; Q326, p. 123), together with Kayser's process of preparing the nickel catalyst. On January 17, 1908, Kayser, with his apparatus and process hydrogenized refined cottonseed oil and produced hardened fats (Q851, pp. 76-78). Five days later, on January 22, 1908, in the presence of Anderson, Kayser hydrogenized a second batch of cottonseed oil.

The Petitioner succeeded in securing from Mr. Burchenal, what, so far as the Petitioner knows, are the only original records of Kayser's work, some six in number, which are reproduced on pages 75-78 of the Record.

The first record described the process as follows:

> "Hydrogen gas is circulated through the machine and when all air is expelled a gas flame is placed under the tank to heat oil to 160° C. The process of saturation is very

interesting. Hydrogen is circulated as taken up by the fat. If too much is passed into the machine, the excess passes out of the outlet and is wasted. If not enough passes in a slight vacuum is created, which causes the water, in which end outlet tube is placed, to rise up in the tube, sometimes 6 to 8 inches. The affinity of the fat for the hydrogen is plainly evidenced in this operation. As the saturation nears completion, less gas is, of course, taken up by fat, and an excess is circulated, which causes bubbling at end of outlet tube. Completion of saturation is indicated by comparison of volume of gas in and out of machine. When saturation is practically complete, the gas passes through without any apparent reduction in volume. The fat is drawn out of the machine—a black mass on account of presence of catalyzer, and passed through filter press, the catalyzer filtering out very readily. The filtered fat is the finished product." (Rec., pp. 75-76.)

The second record refers to the operation of the apparatus and process by Kayser and shows the *progressive* nature of the reaction. At three hours the oil was hardened to 55.5° C.; and at six hours to 60.3° C. This is the record which contains the analysis by Dr. Bender of the incompletely hydrogenized samples brought by Kayser from Crossfield's as having an iodine value of 55.26 and a melting point of 39.3° C., to which reference has already been made. *Another* sample at the laboratory melted at 49.9° C., as noted by Dr. Bender in parenthesis.

The batch of oil hydrogenized on Jan. 22, 1908, as disclosed by the third record of that date, produced products of 55° C. and 60° C., after three and six hours respectively. On March 5, 1908 (p. 76), the fourth record shows that Kayser produced two batches of partially hydrogen-

ized cottonseed oil melting respectively at 42° C. and 43° C. the melting point specified in Burchenal's application as filed. Kayser was demonstrating his process and, of course, demonstrating the different products he could produce thereby.

These various products were disclosed both to Burchenal and to Anderson (Q326, p. 123; Qs. 385, 386, p. 33).

Burchenal testified:

> "Q385. And reports were made by Mr. Kayser to Mr. Anderson? A. Yes.
> "Q386. And it was from Mr. Anderson that you obtained your knowledge of the reports? A. *Oh, no; I was in touch with them daily.*" (Rec., p. 33.)

On March 20, 1908, Kayser filed an application for patent, which was granted September 26, 1911, No. 1,004,035; and on February 18, 1910, he filed a second application, on which patent No. 1,008,474 was granted November 14, 1911. These two patents appear respectively on pages 571 and 575 of the record. They show the apparatus and process of hydrogenating oils, which were disclosed by Kayser to Burchenal.

The first patent No. 1,004,035 describes a process in which the Normann method of hydrogenation is accomplished, by placing a mixture of oil and the catalyst in a closed heated vessel, and a paddle wheel propels portions of the mixture through an overlying body of hydrogen to bring about the contact of the hydrogen, oil and catalyst.

The patent states that

> "The time of treatment will vary with the progress realized and *with the degree of saturation aimed at*" (p. 574 lines 46-48).

thus leaving it to anyone practising the process,

to carry on the process until the desired degree of saturation is secured, *i. e.* to produce a product which is slightly viscous, semi-solid or solid.

In parallel columns we reproduce the processes described in the Burchenal patent in suit, and in the second Kayser patent No. 1,008,474.

KAYSER, 1,008,474.

It is by now well-known that unsaturated fatty acids, their glycerides or other esters in a fluid state, can be made to absorb gaseous hydrogen, until they become converted into the corresponding semi-saturated or saturated compounds by the intervention of certain finely divided metals, nickel in particular (page 1, lines 11-18).

In practice, the oil to be hydrogenized, for example cottonseed oil, is preferably charged into the cylinder through the manhole 2 to about the level indicated. A relatively small amount of the nickelized catalyzer, usually less than one per cent. by weight of the oil, is also introduced. The mixture is then heated by steam in the jacket 3 to a temperature of about 150° to 160° C. Hydrogen is pumped into the cylinder through the pipe 4, the unabsorbed excess

PATENT IN SUIT.

In manufacturing this product, cottonseed or other vegetable oil is caused to chemically absorb a limited amount of hydrogen by reacting on the oil with hydrogen in the presence of a catalytic agent and at an elevated temperature. The oil is preferably agitated in a closed vessel in the presence of an atmosphere of compressed hydrogen, a catalyzer of finely divided nickel carried by kieselguhr being maintained in suspension in the oil, and its temperature being raised to about 155°

escaping through the pipe 5 and relief-valve 12, and the wire-gauze beaters are set in motion. The heat supply of hydrogen and agitation are continued until the oil has been hydrogenized to *the desired degree, as shown by its consistency or by determination of its titre and iodin value,* usually for several hours and until it has been converted into a product which is solid or *semi-solid* when cold. The cock 16 is then opened, the mixture of hydrogenized oil and catalyzer is run out through the tap 15, and the catalyzer is filtered out for re-use (p. 2 of patent, lines 82-105, pp. 576-577).

C.

According to the present invention, the amount of hydrogen absorbed is carefully regulated and limited. In practice, the operation is stopped when the oil has been converted *into a product which cools to a white or yellowish semi-solid* more closely resembling lard than do the commercial mixtures of cottonseed oil and animal oleo-stearin (p. 1 of upatent, lines 75-96).

The foregoing comparison shows that the two processes are identical and that semi-solid products are produced by both, and that by Kayser's process, a partially hydrogenized product of any desired melting point and iodin value may be secured. As ~~we shall~~ shown ~~in the discussion of~~ the File Contents, it was to differentiate from the disclosure of these Kayser patents that Burchenal amended his specification by including a definition of the term "*lard-like,*" as meaning a body like lard—very low in linolin and high in olein, and inserted the term "lard-like" as thus defined in his claims in suit.

Mr. Burchenal testified that the process disclos-

ed in the Kayser patent is the same as that which Kayser disclosed to him in 1908.

> "Q754. * * * is the process described in the Kayser patent 1,008,474 materially different from the process practised by Mr. Kayser in the early part of 1908? A. As I understand the patent, it is not materially different.
>
> "Q755. That is, the process which is described by Mr. Kayser in this patent is not materially different from the process which he practised in the early part of 1908 at the Procter & Gamble Company's factory? A. Yes.
>
> "Q756. Referring now to Question 334, is there any difference in the process of hydrogenation described in the patent in suit and the process which was carried out by Mr. Kayser in the early part of 1908? A. As I understand that paragraph, it does not refer to any special process, except where it says 'preferably'; but preference was given to the process in a general way as outlined in the Kayser patent.
>
> "Q757. That is, so far as the process is described in the patent in suit, it is the same process which Mr. Kayser had carried on in the early part of 1908, in the hydrogenation of oils, and particularly cottonseed oil? A. The process of hydrogenating, yes.
>
> "Q758. And your knowledge of this process was gained from Mr. Kayser? A. Yes" (Rec. pp. 67, 68).

After testifying that these patents were obtained by Kayser with his knowledge and approval (Q419-421, p. 37) Mr. Burchenal distinctly disclaimed inventorship of the *process* or any part by which solid or semi-solid hydrogenized cottonseed oil products were produced, as follows:

> "Q422. And you do not claim to be the inventor of any of the processes, or parts

thereof, which are described in the specification of these two Kayser patents, do you? A. No" (Rec. p. 37).

Kayser's process, as described in the Kayser patents No. 1,004,035 and No. 1,008,474, includes hydrogenizing cottonseed oil until it has been converted into a product "which is * * * semi-solid when cold," or until it has reached "the desired degree as shown by its consistency or by determination of its titer and iodine number."

Cottonseed oil is edible and a food product. When it is hydrogenized to a semi-solid state, by carrying on the process until the product is of the desired degree of consistency (as described in the Kayser patents, and disclosed to Mr. Burchenal), there is inevitably produced by the law of that process a food product consisting of "incompletely hydrogenized" cottonseed oil. When this material is subjected to the usual processes to which extracted hog fat is subjected, it becomes a homogeneous white or yellowish semi-solid food product of lard-like consistency. It has been shown and it is conceded by the Respondent, as hereinbefore set forth, that an edible oil is edible at any stage of hydrogenation so that any edible oil hydrogenized by the process of the Normann patent or the Kayser patent to a semi-solid state is an edible food product.

That Kayser knew that he could and was in fact producing edible cooking fats was shown by the evidence of a disinterested witness—Clarence von Phul—Kayser's friend and confident (Q25, p. 250; Qs41, 42, p. 229), with whom Kayser made his home from November, 1907, until March, 1908 (Q11, p. 248).

VonPhul testified that Kayser told him, soon after vonPhul returned to Cincinnati in Novem-

ber, 1907, that he was "getting up a patent on a food product" (Q14, p. 227) and that "He was producing a food from cottonseed oil by a chemical action," without explaining to vonPhul, who was not a chemist, the chemical process (Qs. 16, 17, p. 228); and that later in January, 1908, Kayser brought home a sample of the hard product just made and showed it to vonPhul. (Q19-25 p. 28; Q21-24. p. 249).

As indicating Kayser's having confided in vonPhul, it appears that vonPhul, who had some ability as a draftsman, at Kayser's request and from explanations and sketches furnished by Kayser, made the drawings, from which Kayser's Patent Office drawings of Kayser's patent No. 1,004,035 were copied (Qs. 29-40, pp. 228, 229).

Kayser, from January to March, 1908, made about 450 pounds of hard hydrogenized oil and Mr. Procter, President of the Respondent Company, arranged with Mr. McCaw, then President of the McCaw Manufacturing Company, at Macon, Georgia, to have that hard fat substituted for oleo stearin in the manufacture of artificial lard. The McCaw Manufacturing Company was at that time making a white high-grade artificial lard or lard substitute called "Flake White," which then, in 1908, was produced by adding oleostearin to cottonseed oil in accordance with the well-known processes.

The substitution of the hard hydrogenized fat for the equally hard oleo stearin in the production of artificial lard or "lard compound" was the first natural step to take, *but there is no evidence connecting Mr. Burchenal therewith.* Mr. McCaw did not then know Mr. Burchenal and was but slightly acquainted with Mr. Procter.

According to McCaw's story, in February or

March, 1908, Procter called at McCaw's New York office, showed him a sample of Kayser's hydrogenated fat and asked him if he would make imitation lard in which hydrogenized oil was substituted for oleostearin. Procter gave no hint or instructions to McCaw as to how Kayser's hydrogenized fat should be mixed with the cottonseed oil or their proportions, but left the whole matter to McCaw. By May, 1908, Kayser had produced about 450 pounds of hard hydrogenized cottonseed oil, and this was sent by Mr. Procter to McCaw, who substituted it for oleo stearin in the production of 3,000 pounds of lard substitute, made in three batches of 1,000 pounds each. These batches varied only in the proportion of hydrogenized fat to cottonseed oil.

> "Q. You were left to your own resources in making up the mixture? A. Oh, absolutely, at that time" (McCaw, Q277, p. 184).

McCaw testified that he followed the usual and ordinary method of mixing the fat with the cotton seed oil according to the titer of the former, first melting the fat and after mixing or blending it with the oil, subjecting the mixture to the usual deodorizing, refrigerating and aerating treatments to which his "Flake White" had long been subjected (Qs271, 274-276, pp. 183, 184).

Subsequently a second batch of 1,000 pounds of hydrogenized oil produced by Kayser was sent to McCaw in September, 1908, and about 10,000 pounds of artificial lard or lard compound produced by blending it with cottonseed oil, but the product was regarded by McCaw as not merchantable because of its dark appearance evidently due to faulty treatment in the usual process of deodorizing, refrigerating, and incorporating air, therein. (Qs. 80-192, pp. 87-89).

The Procter & Gamble Company evidently was satisfied with the results for, in the fall of 1908 and winter of 1909, the Respondent erected a large commercial plant for hydrogenizing oils, reproducing on a commercial scale the small plant which Kayser had built in December, 1907, and January, 1908. This commercial plant was started in operation on February 15, 1909 (Qs. 152-156, p. 15), and in March, 1909, a carload of Kayser's hydrogenized oil was shipped to the McCaw plant, which in the meantime had been purchased by the Respondent (Q113, p. 90). This hardened product was the same as that previously sent in May and August, 1908 (Qs972-974, p. 151). The carload of hardened fat was made into lard compound or artificial lard by blending it with cottonseed oil and some oleo stearin. It was placed on the market and sold under the same trade name, Flake White. Subsequently, oleo stearin was entirely omitted, and only hardened or hydrogenized fat, used for blending with the oil.

Mr. McCaw testified that the character and use of Flake White was not changed by the substitution of hard hydrogenized cottonseed oil for oleo stearin.

> "RDQ190. And the Procter & Gamble Company have since continued to sell the compounds, Planteen, Flake White and Invincible, under the same name under which they were sold by you prior to the acquisition of your business by The Procter & Gamble Company? A. Those three brands have been continued, yes.
>
> "RDQ191. And there has not been any objection on the part of the users of those brands to the compounds? A. None that I have heard of.
>
> "RDQ192. They would just as soon have

one as the other, the old compounds or the new compounds? A. So far as my knowledge goes.

"RDQ193. It doesn't make any difference at all? A. So far as my knowledge goes.

"RDQ194. You would be likely to know if there were? A. I should think so.

"RDQ195. In other words that is part of your business to know? A. Yes" (Rec. p. 99).

There is nothing in the testimony of McCaw, Anderson or Procter, all officials of the Respondent Company, or even of Mr. Burchenal, connecting Mr. Burchenal with the production of an artificial lard consisting of cottonseed oil hardened to a lardlike consistency by incorporating therein hard fat resulting from the hydrogenation of cottonseed oil.

Mr. Burchenal inferentially claims that he was responsible for the production of a semi-solid food fat obtained by the process of carrying on the hydrogenating process until the product is semi-solid on cooling, instead of carrying on the hydrogenating process until the final product was hard on the cooling, and adding the melted hard fat, in proper proportion, to cottonseed oil, as had been followed in making Flake White. Whether he did or not is of no great importance in any event, since the patent in suit is not for a process. In any event he is not corroborated in his claim, for incompletely hydrogenized oil was an old product.

It appears that Kayser, who had fully disclosed the process described in the patent in suit to Mr. Burchenal, and who produced semi-solid products, of a melting point of 42° C. and 43° C. (Rec. p. 77), and had demonstrated to Burchenal the statement in Kayser's patent that semi-solid

or incompletely hydrogenized products might be produced as desired, returned to England in July, 1910. The Burchenal patent in suit was applied for on November 10, 1910, after Kayser left this country.

Mr. Morrison, Respondent's chemical superintendent, testified that Kayser was responsible for the experimental work in hydrogenizing oils.

> "Q169. Who was actually doing the experimentation in hydrogenizing oils in the laboratory? A. At what period?
> "Q170. Prior to November 10, 1910? A. Mr. Kayser, up until he left in 1910 * * *" (Rec. p. 214).

It is quite clear that the statement of the Court of Appeals to the effect that no chemist for a "score of years" had produced imitation lard by incomplete hydrogenation, may, we think, be fairly criticized either as an exaggeration, or an error. The first discovery by Normann of the possibility of hardening oils by hydrogenation was not published until 1903. From 1903 to 1907 Crossfield & Son, Ltd., with the assistance of Normann and Kayser was commercially developing the process in England. When Kayser arrived in this country in the late autumn of 1907 to exploit it here, and early in 1908 had completed his experimental plant, the first use of the hydrogenized oil, was in making imitation lard, and as soon as the hydrogenized oil was commercially available, it was used in making Flake White.

The artificially produced stearin was at this time cheaper than the natural animal stearin and it appears that at this time a saving by using the completely hydrogenized cottonseed oil as a substitute for the oleostearin in the old "Flake White" mixture, could be effected (McCaw XQ 188, p. 98).

To take full advantage of this fact, it was necessary for the respondent to use its limited hydrogenizing capacity to completely hydrogenize a portion (approximately 10% to 15%) of the final product. In that way its output was multiplied ten times as compared with the output which would result if the entire product was partially hydrogenized.

Just as soon as respondent had completed its new hydrogenizing plant of large capacity, it began to make the patented product by partial hydrogenation. The output of the plant had, of course, been calculated to meet the commercial requirements. Therefore, it was no longer profitable to follow the plan of completely hydrogenizing only a small percentage of the output.

Thus the situation is one in which it cannot be urged in support of the patent that the patented product is one long sought for and never before produced. On the contrary the product was at once produced just as soon as it became commercially profitable to produce it.

All these hydrogenized products were the direct result of the Normann process as brought to this country by Kayser.

There was no lapse of a "score of years" as erroneously stated in the opinion of the Court of Appeals; on the contrary the process devised by Normann in 1903 and perfected by Crossfield & Son, Ltd., in 1907, was immediately put into use for the manufacture of artificial lard, as soon as Crossfield's chemist, Kayser, brought it to this country.

It is plain from the foregoing that Burchenal did not invent the *process* of hydrogenation described in the patent in suit, and that he was

not the first to produce incompletely hydrogenized cottonseed oils.

The District Court said:

> "It is also noteworthy that Kayser refused to testify in this case [1] and that the witnesses as to the work of Kayser in America are officers or employees of the complainant. Under such circumstances the meagerness of the evidence which has been adduced to show that Burchenal had anything to do with the development of the lard-like food product which is the subject of the patent in suit, coupled with his admissions that the entire process under which it was made was the work of Kayser is most significant and makes it impossible to find that Burchenal invented anything. * * * No step was taken by Burchenal that could possibly amount to invention.
>
> "Complainant urges that the experiments of Kayser and the patents of Normann and Kayser aimed at complete saturation and that neither realized the importance of a partially hydrogenized product. But the process under which their products were made involved in its progress partial hydrogenation and Kayser's patent No. 1,004,035 distinctly stated that 'The time of treatment will vary with the progress realized and with the degree of saturation aimed at.' * * * Kayser's process was the complainant's process and his product involved a progressive reaction fitted for any purpose. The broad discovery as between him and Burchenal certainly belongs to him" (Rec. p. 764).

In Judge Ward's dissenting opinion in the Court of Appeals, he said:

> "I think the District Court was right in holding the patent void for lack of invention. It was well known that a vegetable oil could

[1] (Barrows, pp. 399-402.)

be changed chemically into a hard fat by hydrogenation and of course that at some stage of the process before complete hydrogenation it would be a homogeneous semi-solid. It was also known that the process would not affect the edibility of the product. The product at all stages of the process was therefore old and open to the public for any use of which it was capable. To apply it when semi-solid as a substitute for animal lard in cooking was no doubt novel and useful but was not in my opinion invention. To one skilled in the chemical art such a use was as obvious if he thought about it at all, as were many mechanical improvements which, though new and useful, have been held not to be inventions because within the capacity of those skilled in the particular art" (Rec. p. 779).

The Court of Appeals, in its majority decision, in respect of Kayser's work, said in part:

"When Kayser began to produce by his processes a hard fat, it occurred certainly to Mr. Procter (the plaintiff's President) and not improbably to Kayser himself, that since substantially saturated cottonseed oil was a fair commercial equivalent for animal stearin, that since frying and shortening compounds were largely manufactured by combining animal stearin with cottonseed oil, so they might be made by mechanically mixing liquid oil and hardening oil. * * *

"We are satisfied of the truth (entirely apart from all presumptions) of defendants' testimony that it was not until Kayser had returned to England, or was on the point of going, that it occurred to anyone that it was not necessary *to first harden by hydrogenic saturation cottonseed oil and then mix it with the fluid article in order to make a lard-like compound; but that the hardening process might be arrested in the manner and for the purposes disclosed by Burchenal's application.*

> "Assuming now that this *mental operation or discovery* in the sense of the patent law (Walker on Patents, 5th Ed. Sec. 2) amounted to invention, we not only find no evidence that Burchenal was not the inventor, but it is a strain upon credulity to believe that when this plaintiff corporation might just as well have advanced an application in Kayser's name it deliberately preferred the fraud of prosecuting it in that of Burchenal" (Rec. p. 777). (Italics ours.)

In the foregoing quotation, it is apparent that the Court of Appeals did not have in mind the *product or thing* of the patent, but was thinking only of the *process,* and we have italicized what the Court evidently regarded as the step made by Burchenal. But that step or "mental operation or discovery" was a *process*—not the creation of a *new product.* It assumes the product—"a lardlike compound"— to be old and treats the patent as though the claim called for a *process,* namely, *arresting the hydrogenizing process "in the manner and for the purposes disclosed by Burchenal's application,"* and contrasts this process with that previously followed in making the "lardlike compound," which was by *first* hydrogenizing the oil to saturation and *then* mixing the hardened oil with the fluid article.

So, even if it be conceded that the step or process is new, which we submit is negatived by the Record and by the District Court and Judge Ward in his dissenting opinion, and is the invention or discovery of Burchenal, it does not establish the validity of the patent—for the ultimate *product* is *old.*

Cochran vs. Badische, supra;
The Wood Paper Patent Case, supra.

Petitioner's Product is not the Product as Defined in the Patent in Suit.

As pointed out in the main portion of the brief, Petitioner's product is different from the specific product defined in the specification of the patent in suit. That this is so is emphasized by the fact that there is no charge that Kream Krisp is an infringement of claims 3 to 7 inclusive, of the patent in suit.

It has been shown that Petitioner's product is not like the product which the patentee stated was his object to produce—namely, one which, like lard, is low in linolin and high in olein, and consequently Kream Krisp in this respect is not the "lard-like" product of the patent.

In other respects which will now be set forth, Kream Krisp fails to correspond to the patented product, but is substantially like the prior art artificial lard. Like such artificial lard, it is a mixture (a) a mixture of solid and liquid glycerides, and (b) a mixture of cottonseed oil and hard fat produced by hydrogenation of some of the liquid glycerides thereof.

Petitioner's Product has not the Iodine Value Specified in the Patent.

When cottonseed oil, which has an iodine value of 108-110, is subjected to the Normann or batch process recited in the patent in suit, the resulting product of the patent is said to have an iodine value of 55-80. The iodine value of Petitioner's product is 94.7, and thus entirely outside of the range specified in the patent in suit. Thus:

	Batch Process.			Petitioner's Continuous Process.		
	Cotton-seed oil.		Patented product.	Cotton-seed oil.		Petitioner's product.
Iodine value	108-110	to	55-80	108-110	to	97.4

The batch or Normann process of the patent and the continuous or Moore process followed by the petitioner are thus not only different, but the resulting products are also different in chemical composition and in iodine value. Instead of having, as a result of Defendant's process, a product having a *low* iodine value, and which is *low in linolin* and *high in olein*, as in the patent in suit, there is produced a product having a *high* iodine value, and *in which the linolin constitutes over one-third of the product*, while the olein is not appreciably increased.

Petitioner's Product cannot be Produced by the Process described in the Patent in Suit. Nor can the Product of the Patent be Produced by Petitioner's Process.

Mr. Richter testified that he had many times tried to produce by Petitioner's process, the mixture of glycerides specified in the patent, but it could not be done.

> "Q219. In your experience, have you ever noted in defendant's product produced by the hydrogenation of cottonseed oil any material having the proportions of the component glycerides falling within the following range, to wit: saturated glycerides 20 to 25 per cent.; olein 65 to 75 per cent.; and linolin 5 to 10 per cent.? A. We have never pro-

duced such a product by defendant's process.

"Q220. Have you ever tried to produce such a product by means of defendant's process and apparatus? A. Yes; many times.

"Q221. What resulted from your trial? A. The result invariably leads to this; the product obtained contains a large percentage of stearin; a relatively large per cent. of linolin and the olein content of the original oil does not change very appreciably. In other words, by varying different factors in this process we are not able to realize the product which is stated in your question." (Rec., p. 379.)

He testified, likewise, that, by following the batch process described in the patent in suit, it is impossible to produce a product having the proportions of glycerides present in admixture in Kream Krisp (Qs. 222, 223, p. 380).

The Amount of Hydrogen Absorbed is Different from that Recited in the Patent in Suit.

In producing the product of the patent in suit, the specification states that:

> "According to the present invention, the *amount* of hydrogen absorbed is carefully regulated and limited" (lines 87-89, p. 1).

The *amount* of hydrogen which is absorbed is stated to be "from about 1.5 to 2.5% of additional hydrogen more than in the nonhydrogenized material" (p. 2, line 5). By this careful regulation of the amount of hydrogen, to wit, 1.5 to 2.5% more than in the original oil, there is produced by the batch process of hydrogenation a product which is like hog lard in its low iodine value of 55 to 80, in its titer of 35° to 42° C., in its small proportion of linolin and its high proportion of olein.

In Petitioner's product, there is less than .9 of 1% (.875% to be exact) of hydrogen more than in the cottonseed oil (Richter, Q197, p. 377). In other words, in making Defendant's product, there has been absorbed about one-third to one-half only of the amount of hydrogen absorbed in making the patented product. In Defendant's process, this small amount of hydrogen produces a product having a high amount of linolin, a low amount of olein, and substantially the same amount of saturated fats that are characteristic of the prior art "commercial mixtures" or artificial lards.

The Melting Point of Petitioner's Product Common to all Artificial Lard.

The melting point, and the titer, are the sole characteristics mentioned in the patent in suit which ~~is~~ are common to Defendant's product, to lard, and to the patented product; but alone these are no distinctive tests of identification, for all lard substitutes have approximately the same melting point and titer as hog lard. Moreover, the patentee himself, in the prosecution of his application, changed the melting point and the titer originally stated in his specification, and discarded the melting point in favor of iodine value as a mark of identification, saying:

> "* * * these products have no sharp or definite melting point, and in view of the wide variety of melting-point methods employed by chemists and the different values obtained thereby, claim 3 has been amended to specify the range of iodine values of applicant's products, rather than their melting point range" (p. 552).

The Halphen Test.

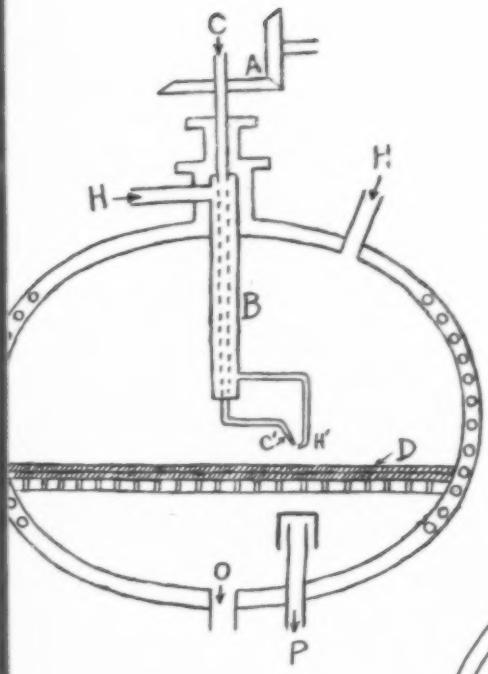
Defendant's products (except the sample introduced in evidence, which had been overheated and therefore lost its ability to respond to the test (Richter, Qs. 30-37, p. 360), when subjected to the Halphen test, shows the presence of cottonseed oil in the product.

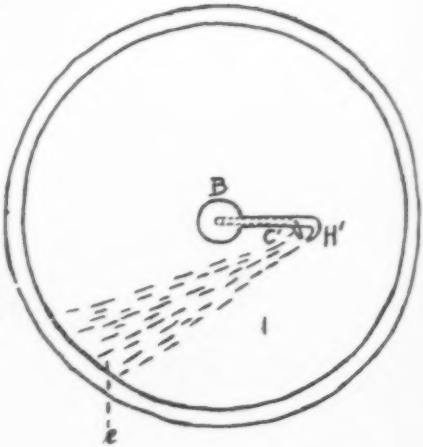
> "We always secured positive results in this reaction, never before have we secured a negative result" (p. 360).
>
> " * * * I said that we have applied the Halphen test to Kream Krisp very many times, and that the first sample that we ever received or tested to show a negative result was a sample [the particular exhibit of Kream Krisp in the case] that Mr. May forwarded to us" (p. 388).

Even if defendant's product should or ever did fail to respond to the Halphen test, that would not be an indication that cottonseed oil is not present therein.

> "Hence the Halphen color reaction can be obtained with lard, etc., which are absolutely free from admixed cottonseed oil. It should be further noted that *failure to obtain the color* in the Halphen test *does not* prove the absence of cottonseed oil." (Lewkowitsche, Vol. 11, p. 204, 5th Ed.)

The minute chromogenetic substance in cottonseed oil, which causes it to give a red coloration when subjected to the Halphen test, if absent from cottonseed oil, does not change the latter to something else *for it is still cottonseed oil*, just as it is cottonseed oil if it has been heated to a high temperature so as to destroy its ability to respond positively to the Halphen test (Richter, Qs. 35-38, p. 361), as already stated in this brief.





(Walker Diagram II)

Petitioner's Apparatus is Different from that of the Patent in Suit.

Defendant's apparatus and process, both of which are novel, are, as has been stated, the invention of Mr. Moore as shown by his patents, 1,121,860, dated December 22, 1914 (filed February 26, 1914), and No. 1,184,480, dated May 23, 1916 (filed October 21, 1914) (pp. 681, 692), and under which the defendant is operating, and these patents, together with Dr. Walker's description and the photographs which are reproduced in the record, clearly disclose the construction of the apparatus and the various steps of the process. The hydrogenating apparatus or "hydrogenator" (or "capsule", as it is sometimes referred to) is shown roughly in the sketch, (Walker Chart or Diagram No. 11), opposite page 304 of the record; and is here reproduced.

Dr. Walker describes the operation as follows:

> "A35. Taking up, first, the process as used at the Berlin Mills Company, it will be recalled that in order to get the hydrogen to unite with the fat it is necessary to have the hydrogen and the fat in contact with the nickel. It was obvious to Moore that in a process of this type where we bubble the hydrogen through the oil, that the contact of the hydrogen with the oil was very imperfect because at all times the nickel was enclosed in or covered with oil. It occurred to him that if he could devise a method by which at times the hydrogen would blow off the oil from the nickel he could then saturate the nickel, as it were, with hydrogen, and then when the oil film was brought on he would get a rapid and complete reaction. That conception proved to be a valid one, and he constructed an apparatus of this type as shown in Chart No. 11.

"Looking now at Chart No. 11, the hydrogenator is a cast iron or boiler plate shell, of which the cross section is round. Supported at the periphery and extending from one side to the other to divide the shell into two parts is built a diaphragm or partition consisting, first, of a cast iron plate filled with holes, upon which he built up his nickel catalyzer. It is necessary in order that the nickel catalyzer may be made active not to allow it to come in contact with the air before the oil reaches it. Mr. Moore, therefore, built up the catalyzer bed with nickel oxide instead of nickel and then reduced it to nickel from the nickel oxide *in situ*, as it were, after he has it in place. That is, he then passes through his bed of catalyzer, namely, the nickel, a strong current of hydrogen which passes down from the pipe H through the bed of the catalyst and passes out through the place at the point P. That has the effect then of saturating the nickel with hydrogen. He then passed the oil down the center tube at C, and allowed it to discharge at the end of the point C at the orifice C'. He brought then a current of hydrogen in at H which came down through the spindle of the tube C and out of the tube H'. Here he met then the oil as it passed from the jet C', with a stream of hydrogen and atomized the oil in exactly the same way as we atomize any disinfectant, for example, when we wish to clear out our throat or nose. This made a fog or spray of oil in an atmosphere of hydrogen. When this oil then reached the catalyst the hydrogen blew it through the catalyzer bed, as it were, and we had then the triple contact of the nickel, hydrogen and the oil."

"Now, in order to make the contact periodic, he revolved this shaft so that this spray of oil rotated around the center here. This apparatus is represented in section in the lower figure. This is a plane view in which we have turned the jets a little bit in order

to make them somewhat clear. The hydrogen atomizes the oil in a segment of about 15 degrees. Now, as this jet rotates about its axis as it is discharging oil upon the catalyst it continuously discharges the oil upon a fresh surface of catalyzer. When the oil is not being discharged on one area of the catalyzer, the hydrogen is pushing through the whole diaphragm, so that it is washing away from that part of the catalyzer on which no oil is being deposited at that time, the oil film which was there, and is, therefore, saturating the nickel constantly with hydrogen. The result is that, whereas, it took two or three hours in an apparatus of that kind in which the hydrogen is bubbled through the oil to get a hardening effect, namely, so that enough of these double bonds are saturated with hydrogen to convert enough of the linolin and olein over to the stearin to make it hard, here it is done in a fraction of a second. It takes a good deal less than a second for the oil to pass through the catalyst and one passing through hardens the oil. That is, once passing through the diaphragm, the oil then passes out of the orifice D and is a hard product." (p. 306.)

"XQ124. Would it be correct to say, then, that in defendant's processes, the cottonseed oil is caused to absorb a limited amount of hydrogen by reacting on the oil with hydrogen in the presence of a catalytic agent, and at an elevated temperature? A. It would be more accurate to say that a portion of the cottonseed oil was made to react with hydrogen at an elevated temperature because of course there is a relatively large portion of the oil which passes through the capsule and is not acted on by the hydrogen at all.

"XQ125. How do you know that a fact? A. Because in the oil we have approximately 22 per cent. stearin which cannot be acted on by hydrogen; we have in the final product some 34 per cent. of linolin which has not

been acted on by hydrogen. We have in the final product about 33 or 34 per cent, of olein which may not have been acted on by hydrogen at all. So that the only percentage of the oil which has really been acted on by hydrogen is not more than 14 or 15 per cent." (Rec., p. 329.)

One of defendant's hydrogenators is shown in the photographs opposite page 312, with the door open to show the spray nozzles, the lower photograph being taken through the open door.

In the record, page 702, there is still another photograph of the interior of defendant's hydrogenator, the picture being taken through the open door and showing how the stream of oil is blown into a fine mist or fog by the blast of hydrogen. In addition to the hydrogenating apparatus, there are a number of instrumentalities which are employed in the treatment of the material, including the heaters by which the oil and hydrogen are heated before they are admitted to the hydrogenator, the apparatus by which the hydrogenated material is deodorized, according to old and well-known standard practice employed in the manufacture of lard compounds, and the chilling rolls and pickers by which the material is chilled and aerated in accordance with common standard practice. These various photographs are found between pages 312 and 317 of the record, and there is a brief description of each given by Dr. Walker.

The plant is shown diagrammatically by the drawing which is reproduced on reduced scale opposte pages 306 and 312, but of which there is a full-sized duplicate which forms a part of the exhibits in the case and to which reference may be had, and on which the names of the parts are printed. It is manifest, of course, that neither

the patent in suit nor the Kayser patents disclose or suggest either the novel process followed by the Petitioner in producing Kream Krisp, or the apparatus such as employed in the manufacture thereof.

The Petitioner, in the usual chilling and aerating apparatus in treating thehydrogenized product, follows standard practice, such as was followed by McCaw in manufacturing the original Flake White long before Kayser came to this country; that is, subjects it to the usual treatment with Fuller's earth, and then to a deodorizing operation, and then passes the product over the lard rolls and picking apparatus for the purpose of rapidly chilling the oil and beating air into it, just as artificial lard and lard are treated to produce the same result. It is plain to be seen that the Petitioner has borrowed nothing from the Respondent in the production of its product Kream Krisp.

"Burchenal Specification and Claims as Originally Filed and Finally Granted."

SPECIFICATION OF PATENT AS FILED (Rec. p. 533).

This invention is a food product consisting of a vegetable oil, preferably cottonseed oil, partially hydrogenized and hardened to a white or yellowish semi-solid closely simulating lard.

SPECIFICATION OF PATENT AS AMENDED AND ISSUED (Rec. opposite p. 502).

This invention is a food product consisting of a vegetable oil, preferably cottonseed oil, partially hydrogenized and hardened to a homogeneous white or yellowish semi-solid closely simulating lard.

The special object of the invention is to provide a new food product for a s h o r t e n i n g in cooking, in which the liability to become rancid is minimized, and in which the components of such vegetable oils, which are inferior and detrimental to use as such a food product, have been to a large extent converted into a higher and more wholesome form. All such vegetable oils contain glycerids of unsaturated fatty a c i d s, and among these notable quantities of fatty glycerids of lower saturation than olein. It is the presence of these glycerids of lower saturation that seriously

SPECIFICATION OF PATENT AS FILED.

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

affects the rancidity of the material. Oxidation is largely the cause of rancidity, which oxidation weakens the fat at the point of absorption at the double bonds, and these glycerids of lesser saturation readily absorb oxygen from the air at ordinary temperatures, while the more highly saturated glycerids, as olein, only absorb oxygen at elevated temperatures. It is evident therefore, that oils or fats containing notable quantities of glycerids of linolic acid, or of lesser saturation, are distinctly inferior as an edible product to those containing a minimum of these glycerids, with a larger per cent. of olein. On the other hand, while it is important to get rid of the readily oxidizable glycerids of lower saturation, it is also important not to supply too large a per cent. of fully saturated glycerids. The saturated glycerids of the arachidic, stearic, palmitic and other groups are of very small value for shortening inasmuch as it is the li-

Specification of Patent as Filed.	Specification of Patent as Amended and Issued.
	quid fats which contribute this value to the material. Saturated fats however, serve the purpose of congealing the shortening within the food, and thus retain it equally distributed throughout the whole. Oil, liquid at the ordinary temperatures, does not make the best shortening, because, the oil remains liquid, keeping the food in a sbggy condition, and the oil will even settle to the under part of the cooked product and soil the cloth, paper, or whatever it may come in contact with. Moreover, fats of a melting point above the temperature of the human body, 98° F., are not so digestible as fats which are liquid at this point, or which have a melting point below 98° F. It is, therefore, my object in the preparation of my new lard-like[1] composition and food product, and in preparing same from cottonseed oil, to change

[1] "Butter-like" was the adjective used when this sentence was first introduced by amendment.

SPECIFICATION OF PATENT AS FILED.

In manufacturing this product, cottonseed or other vegetable oil is caused to chemically absorb a limited amount of hydrogen by reacting on the oil with hydrogen in the presence of a catalytic agent and at an elevated temperature. The oil is prefeably agitated in a closed vessel in the presence of an atmosphere of compressed hydrogen, a catalyzer of finely divided nickel carried by Kies elguhr being maintained in suspension in the oil and its temperature being raised to about 155° C.

According to the present invention, the amount of hydrogen absorbed is carefully

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

the chemical composition of the oil to obtain a product with a high percentage of olein a low percentage of linolin and the lesser-saturated fats and with only sufficient stearin to make the product congeal at ordinary temperatures.[1]

In manufacturing this product, cottonseed or other vegetable oil is caused to chemically absorb a limited amount of hydrogen by reacting on the oil with hydrogen in the presence of a catalytic agent and at an elevated temperature. The oil is prefeably agitated in a closed vessel in the presence of an atmosphere of compressed hydrogen, a catalyzer of finely divided nickel carried by Kieselguhr being maintained in suspension in the oil and its temperature being raised to about 155° C.

According to the present invention, the amount of hydrogen absorbed is carefully reg-

[1] The phrase *"but below the heat of the blood,"* which had been introduced in the amendment, was subsequently cancelled.

SPECIFICATION OF PATENT AS FILED.

regulated and limited. *In practice, the operation is stopped when the oil has been converted into a product having a melting point ranging from* 36° *C. to* 43° C., *preferably* 41-42° C. This product cools to a white or yellowish semi-solid, more closely resembling lard than do the commercial mixtures of cottonseed oil and animal oleostearin.

The new product has a saponification value of about 195, an iodin value ranging from about 55 to 80, and a titre of from about 35.5° C. to 42.5° C. While but partially hydrogenized, containing

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

ulated and limited. *In practice, the operation is stopped when the oil has been converted into a product which cools to a white or yellowish semi-solid, more closely resembling lard than do the commercial mixtures of cottonseed oil and animal oleostearin* while in many respects the product is superior to the best leaf lard as a shortening.

It is not so liable to become rancid and the product can be heated to a considerably higher temperature than lard without smoking or burning. The high temperature to which my product can be raised without smoking or burning makes the product ideal for frying, inasmuch as a crust forms almost instantly in the food fried which prevents any absorption of the shortening.

A lard-like product thus prepared from cottonseed oil has a saponification value of about 195, and an iodin value ranging from about 55 to about 80. The product having an iodin value of 55 has a titre of

SPECIFICATION OF PATENT AS FILED.

from about 1.5% to 2.5% of additional hydrogen more than in the non-hydrogenized material, it shows no free cottonseed oil when subjected to the Halphen test, thereby differing from all commercial lard substitutes containing this oil.

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

about 42° and a melting point of about 40° C.; that having an iodin value of 80 has a titre of about 35° and a melting point of about 33° C. While but partially hydrogenized, containing from about 1.5% to about 2.5% of additional hydrogen more than in the non-hydrogenized material, it shows no free cottonseed oil when subjected to the Halphen test, thereby differing from all commercial lard substitutes containing this oil.

It contains from twenty to twenty-five per cent. of fully saturated glycerids, from five to ten per cent. linolin and from sixty-five to seventy-five per cent. olein, and an average of a number of samples gives twenty-three per cent. of saturated fats, seven and five-tenths per cent. linolin and sixty-nine and five-tenths per cent. olein, while the cottonseed oil before treatment contained seventeen per cent, saturated fats, thirty-seven per cent. linolin and forty-six per cent. olein. It will thus be seen that I have pro-

SPECIFICATION OF PATENT AS FILED.

While the finished article is preferably the homogeneous product of incomplete hydrogenation, a compound lard substitute may be made by causing the oil to absorb a larger amount of hydrogen, still short of saturation, and mixing the hard product with raw oil. For example, the reaction may be caused to proceed far enough to produce a hydrogenized product having a melting point of 50° C., and equal parts of this product and of raw oil may then be mixed to give an article of the desired consistency.

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

duced an ideal food product, which is high in olein, low in linolin and lesser-saturated fats, and with only enough stearin to make the product congeal at ordinary temperatures.

A lard-like composition comprising edible hydrogenized fatty oil, specifically hydrogenized vegetable oil, is claimed in my co-pending application Serial No. 591,727, filed November 10, 1910.

SPECIFICATION OF PATENT AS FILED.

I claim:

1. A food product consisting of an incompletely hydrogenized vegetable oil, said product being a semi-solid having a melting point ranging from 36° to 43° C.

2. A food product consisting of incompletely-hydrogenized cottonseed oil, said product being a white or yellowish semi-solid having, approximately, a melting point of 40° to 41° C., a saponification value of 195, an iodin value of 55 to 80, and a titre of 35.5° to 42.5° C., giving no reaction for cottonseed oil under the Halphen test.

SPECIFICATION OF PATENT AS AMENDED AND ISSUED.

I claim:

1. A homogeneous lard-like food product consisting of an incompletely-hydrogenized vegetable oil.

2. A homogeneous lard-like food product consisting of incompletely hydrogenized cottonseed oil.

3. A homogeneous lard-like food product consisting of an incompletely-hydrogenized vegetable oil, said product being a semi-solid having an iodin value ranging from about 55 to about 80.

4. A homogeneous lard-like food product consisting of incompletely-hydrogenized cottonseed oil, said product being a white or yellowish semi-solid having, approximately, an iodin value of 55 to 80,

Specification of Patent as Filed.	Specification of Patent as Amended and Issued.
	a melting point of 40 to 33° C., a titre of 42 to 35° C., and giving no reaction for cotton-seed oil under the Halphen test.
	5. A food product, composed of glycerids of saturated and unsaturated fatty acids in substantially the proportions of from twenty to twenty-five per cent. of saturated fats, five to ten per cent. of fats of lesser saturation than olein, and sixty-five to seventy-five per cent. of fats of a saturation corresponding to that of olein.
	6. A food product, composed of glycerids of saturated and unsaturated fatty acids in substantially the proportions of from twenty to twenty-five per cent. of stearin, five to ten per cent. of linolin, and sixty-five to seventy-five per cent. of olein.
	7. A food product, composed of glycerids of saturated and unsaturated fatty acids in substantially the proportions of twenty-three per cent. of stearin, seven and five-tenths per cent. of linolin, and sixty-nine and five-tenths per cent. olein.

SUMMARY OF APPENDIX.

In this appendix we have endeavored, more in detail, to show:

1. Oils and fats,—including lard, prior art artificial lard, Kream Krisp, and the patented product,—are all physically homogeneous white food products, consisting of mixtures of chemically different glycerides in which there is a sufficient percentage of solid glycerides to cause them to assume the semi-solid consistency of lard on cooling to ordinary temperatures.

2. The hydrogenating or hardening process consists in converting, by the addition of hydrogen, certain old and well-known liquid glycerides of an oil into harder, but equally old and well-known glycerides.

3. The gradual addition to an edible oil of solid fats derived from any source,—by hydrogenating the liquid glycerides thereof, or by using oleo-stearin, or previously hydrogenized oil—or any animal or vegetable stearin,—gradually hardens the oil until it reaches a lard-like consistency, and produces an old product, to wit, a white or yellowish homogeneous semi-solid food fat having the attributes and capabilities of lard and suitable for culinary purposes.

4. The identical batch process of hydrogenizing oil (particularly cottonseed oil) set forth in the patent in suit (the Normann process) was developed in England, and disclosed in all its details to Burchenal, including completely and incompletely hydrogenized products resulting therefrom.

5. By the law of the Normann or batch process, the semi-solid products resulting from the incomplete hydrogenation of cottonseed oil have,

and must inevitably have, a low linolin content, a high olein content and sufficient stearin to cause them to congeal at ordinary temperatures. No other directions for producing them are contained in the patent in suit. Being the inevitable result of the Normann process, such products are within the public domain and are not patentable.

6. The commercial development of the process of hydrogenation in the manufacture of artificial lard, immediately followed the introduction of the process into this country, and the production of the patented product naturally followed, as soon as it became commercially profitable.

7. The commercial product, Kream Krisp, made by Petitioner, is produced by a continuous process and by an apparatus markedly different from those of the Respondent. By the law of the continuous process, Petitioner's product is unlike the specific "lard-like" product of the patent, and cannot be produced from cottonseed oil by the batch process of hydrogenation.

8. By ~~Respondent's~~ Petitioner's continuous process the patented product cannot be produced from cottonseed oil.

9. According to the familiar tests of identification employed by food chemists and set forth in the patent in suit, the patented product is identified as like lard derived from hog fat. By these same tests Kream Krisp is not "lard-like," but has all the properties and characteristics of the prior art artificial lard.

10. The changes introduced, by amendment, in the specification and claims, during the pendency of the application in the Patent Office, show that, as issued, the patent is limited and restricted to a product having a chemical composition

different from Petitioner's product; wherefore the claims are not entitled to a construction broad enough to include Petitioner's product as an infringement.

Respectfully submitted

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New York, N. Y. March 8, 1920.